



ISSN (E): 2277- 7695
ISSN (P): 2349-8242
NAAS Rating: 5.23
TPI 2022; SP-11(4): 251-254
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www.thepharmajournal.com

Received: 16-02-2022

Accepted: 18-03-2022

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Sensory properties of functional greek yoghurt incorporated with *Moringa oleifera* leaf powder

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Abstract

This study was designed to develop functional Greek yoghurt by the incorporation of *Moringa oleifera* leaf powder as the source of all kind of vitamins, trace minerals and fiber content. The preliminary trials of functional Greek yoghurt was prepared by incorporating *Moringa oleifera* leaf powder at different levels viz., 0.5%, 1.0%, 1.5%, 2 %, and 2.5 %. Based on the sensory evaluation, 1.5% *Moringa oleifera* leaf powder incorporation was adjudged as the acceptable level in functional Greek yoghurt and subjected to further studies. The overall acceptability scores for control yoghurt (PY) was 8.75 ± 0.11 and the treatments viz., T1, T2 and T3 had secured a comparable score of 8.58 ± 0.15 , 8.33 ± 0.11 and 8.25 ± 0.11 respectively while T4 and T5 had secured the lowest scores of 7.50 ± 0.13 and 6.92 ± 0.15 respectively. Based on the sensory evaluation 1.5% of *Moringa oleifera* leaf powder was selected as the ideal inclusion level for developing functional Greek yoghurt without altering the any organoleptic properties of yoghurt.

Keywords: Functional greek yoghurt, *Moringa oleifera* leaf powder and sensory properties

1. Introduction

A food can be said to be functional if it contains a component (which may or may not be a nutrient) that affects one or a limited number of functions in the body in a targeted way so as to have positive effects on health, or if it has a physiological or psychological effect beyond the traditional nutritional effect (Roberfroid, 2000) [1]. Yoghurt has a good potential for delivery of probiotic microorganisms into human intestine, as well as the high nutritional value of yoghurt constitute growing importance of Greek yoghurt as a potent functional food in food industry.

Fermented products have proven health attributes apart from nutritional values. Among the popular exotic fermented milk products, the consumption of yoghurt in recent decade has increased rapidly due to its higher nutritional and therapeutic properties. It is an excellent source of protein, calcium and potassium. Other benefits include prevention of intestinal infections, improved digestion, and suppression of carcinogenesis and reduction of serum cholesterol concentrations. Since fermented milk products are among highly consumed foods in the world, they have been used to deliver nutritional components into human diet.

Although many healthy and nutritious impacts are well established, milk and its products are generally not regarded as a rich source for vitamin c and bioactive ingredients such as polyphenols and antioxidants (Achi *et al.*, 2019) [2]. In addition, like any other dairy products, Greek yoghurt also lacks dietary fiber. Thus, the formulation of novel dairy products using medicinal herbs or their extracts has got more attention to meet the demand of health conscious consumers (Jamshidi-Kia *et al.*, 2018) [3]. In this regard, inclusion of dietary fiber, antioxidant and vitamin c rich herbs is expected to enhance the nutritional and therapeutic values of Greek yoghurt.

Incorporation of *Moringa oleifera*, which is a rich source of vitamin C, protein, fiber, minerals, alkaloids, polyphenols, carotenoids and flavonoids and subsequent conversion into Greek style yoghurt, will make it a perfect health-giving product (Charoensin, 2014) [4]. The resultant product is anticipated to have particular vital response such as anti-inflammatory, antioxidant, anti-carcinogenic, antihypertensive, anti-spasmodic, anti-diabetic, anti-epileptic, anti-arthritis, diuretic, cholesterol lowering and hepato-protective activities. It is also proposed for different diseases and conditions including anemia, anxiety, bronchitis, chest congestion and cholera (Razis *et al.*, 2014) [5].

Nowadays there is an increasing demand for low calorie foods with high therapeutic properties. The current young generation is moving towards new varieties of healthy foods

with good palatability, low fat content and high health benefits. The development of dairy foods with the addition of medicinal herbs and probiotic is the need of the hour. Hence, it is proposed to develop a Greek yoghurt with low calorie and high health benefits, which will cater needs of health conscious consumers.

2. Materials and Methods

Different treatments of functional Greek yoghurt was designed as follows

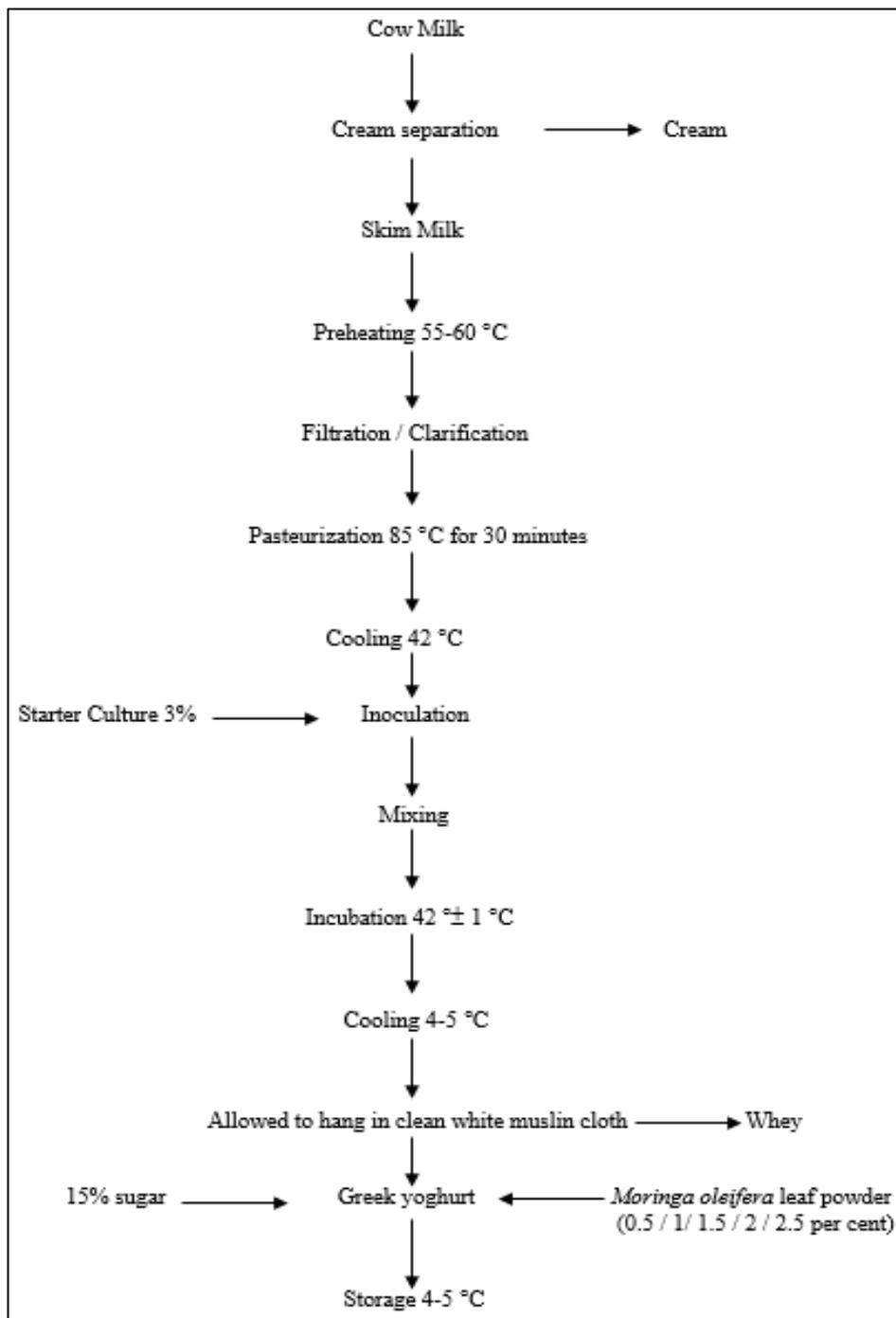
Treatments	Details
Control	Greek yoghurt
T1	Greek yoghurt with 0.5% <i>Moringa oleifera</i> leaf powder
T2	Greek yoghurt with 0.1% <i>Moringa oleifera</i> leaf powder
T3	Greek yoghurt with 1.5% <i>Moringa oleifera</i> leaf powder
T4	Greek yoghurt with 2.0% <i>Moringa oleifera</i> leaf powder
T5	Greek yoghurt with 2.5% <i>Moringa oleifera</i> leaf powder

Plain yoghurt was prepared as per De, (2004) [6]. Greek yoghurt was prepared from plain yoghurt as per the traditional (cloth bag) method described by Yamani *et al.* (1994) [7].

2.1 Preparation of *Moringa oleifera* leaf powder incorporated Greek yoghurt

Different lots of *Moringa oleifera* leaf powder enriched Greek yoghurt were prepared using sugar and salt. Sugar at the rate of 15 per cent (w/v), salt at the rate of 0.2 per cent (w/v) and cardamom at the rate of 1 per 100g were added to the prepared Greek yoghurt. *Moringa oleifera* leaf powder (after being roasted in ghee) was added at five different levels viz., 0.5, 1.0, 1.5, 2.0 and 2.5 per cent. The contents were mixed well using a mechanical blender and finally stored at 4 to 5 °C.

2.2 Process flow chart for the preparation of Greek yoghurt



3. Result and Discussion

3.1 Sensory evaluation for optimization of level of incorporation of *Moringa oleifera* leaf powder in the Greek yoghurt

Table 1 shows the Mean \pm SE values of colour and appearance, flavor and taste, body and texture and overall acceptability scores of different treatment of *Moringa oleifera* leaf powder incorporated Greek yoghurt. It is revealed that no significant ($P \geq 0.05$) differences was observed between different treatments and control except that T4 and T5, which scores

low values in all sensory evaluation and highly differs significantly ($P \leq 0.01$) with other three treatments and control. All the sensory scores were good upto 1.5% level of addition of *Moringa oleifera* leaf powder in the Greek yoghurt. Beyond that level, sensory scores are reduced drastically. Hence, *Moringa oleifera* leaf powder concentration of 1.5 percent was selected as maximum acceptable level of inclusion and incorporated in the Greek yoghurt for further studies.

Table 1: Average scores of sensory evaluation of Greek yoghurt incorporated with different concentration of *Moringa oleifera* leaf powder (Mean \pm SE)

Parameters Treatment	Colour and Appearance	Flavour and Taste	Body and Texture	Overall acceptability
Control	8.67 ^a \pm 0.11	8.83 ^a \pm 0.11	8.83 ^a \pm 0.11	8.75 ^a \pm 0.11
T1	8.42 ^a \pm 0.15	8.75 ^a \pm 0.11	8.58 ^a \pm 0.15	8.58 ^a \pm 0.15
T2	8.33 ^a \pm 0.11	8.50 ^a \pm 0.13	8.42 ^a \pm 0.08	8.33 ^a \pm 0.11
T3	8.25 ^a \pm 0.11	8.42 ^a \pm 0.08	8.33 ^a \pm 0.11	8.25 ^a \pm 0.11
T4	7.83 ^{ab} \pm 0.11	7.75 ^b \pm 0.17	7.67 ^{ab} \pm 0.21	7.50 ^b \pm 0.13
T5	7.58 ^b \pm 0.15	7.67 ^b \pm 0.17	7.17 ^b \pm 0.25	6.92 ^c \pm 0.15

Different superscripts in a column differ significantly $P \leq 0.01$

3.2 Colour and Appearance

It is observed that, no significant ($P \geq 0.05$) difference noticed between T1, T2, T3 and control, but there was a highly significant ($P \leq 0.01$) difference noticed between T4, T5 and other three treatments with control.

Increase in the level of addition of *Moringa oleifera* leaf powder reduced the attractive bright colour of the product and lowered the scores, which may be attributed to the greenish colour of *Moringa oleifera* leaf powder incorporated. These results were in agreement with Madukwe *et al.* (2013) [8] who reported that the colour of the control was preferred over *Moringa* beverages. It is also in agreement with the report of Hassan *et al.* (2016) [8] who stated that the control had higher whiteness than treatment.

Addition of *Moringa oleifera* leaf powder reduced the glossy smooth appearance of the product. This is in accordance with Silva *et al.* (2021) [10], who reported that addition of bovine colostrum significantly lowered the appearance and consistency scores of Greek style yoghurt.

3.3 Flavour and Taste

The current study observed that, with regards to flavor and taste no significant ($P \geq 0.05$) difference observed between T1, T2, T3 and control, but T4 and T5 showed a highly significant ($P \leq 0.01$) difference when compared to control and other three treatments. Zhang *et al.* (2018) [11] reported that the addition of *Moringa* extract to yogurt caused a significant decrease in the flavor score, compared to the control yogurt ($P < 0.05$).

Increase in the level of addition of *Moringa oleifera* leaf powder in Greek yoghurt will reduced the pleasant flavour of the product and lowered the scores, which may be attributed

to the bitter taste of *Moringa oleifera* leaf powder incorporated.

3.4 Body and Texture

Statistical analysis showed, no significant ($P \geq 0.05$) difference between T1, T2, T3 and Control, but highly significant ($P \leq 0.05$) difference was noticed between T4, T5 and other three treatments. Dhawi *et al.* (2020) [12] found that the plain yoghurt sample had the highest degree for the body and texture compared to the yoghurt samples fortified with fenugreek and *Moringa oleifera* seed flours.

It means, the body and texture score declined as the amount of *Moringa oleifera* leaf powder increased above 1.5 per cent, which may be attributed to the fiber content and interaction between the *Moringa oleifera* leaf powder with added sugar.

3.5 Overall acceptability

The overall acceptability scores for control Greek yoghurt was 8.75 \pm 0.11 and the treatments T1, T2 and T3 had secured a comparable score of 8.58 \pm 0.15, 8.33 \pm 0.11 and 8.25 \pm 0.11 respectively. However, highly significant ($P \leq 0.01$) difference was observed between T4, T5 and other two treatments, which may be attributed to the greenish colour, bitterness, high fiber content of *Moringa oleifera* leaf powder and interaction between the leaf powder with added sugar.

Akajiaku *et al.* (2018) [12] evaluated the sensory acceptance of yoghurt using nine-point hedonic scale by incorporating *Moringa oleifera* leaf powder at 0.5, 1, 1.5 and 2 per cent (w/v). The scores of probiotic yoghurt mixed with 1 per cent *Moringa oleifera* leaf powder was significantly higher than that mixed with 0.5, 1.5 and 2 per cent ($P < 0.05$).

Table 2: Overall acceptability scores of Greek yoghurt incorporated with different concentration of *Moringa oleifera* leaf powder during different storage period in 7 °C (Mean \pm SE)

Storage Period Treatment	7 th Day	14 th day	21 st day	28 th Day	35 th Day
Control	8.75 ^a \pm 0.11	8.67 ^a \pm 0.11	8.67 ^a \pm 0.11	8.67 ^a \pm 0.11	8.58 ^a \pm 0.08
T1	8.58 ^a \pm 0.15	8.50 ^a \pm 0.13	8.50 ^a \pm 0.13	8.50 ^a \pm 0.13	8.42 ^a \pm 0.08
T2	8.42 ^a \pm 0.15	8.33 ^a \pm 0.11	8.33 ^a \pm 0.11	8.33 ^a \pm 0.11	8.25 ^a \pm 0.11
T3	8.33 ^a \pm 0.11	8.25 ^a \pm 0.11	8.25 ^a \pm 0.11	8.17 ^a \pm 0.17	8.17 ^a \pm 0.11
T4	7.83 ^{ab} \pm 0.11	7.50 ^b \pm 0.13	7.50 ^c \pm 0.18	7.25 ^b \pm 0.11	6.75 ^b \pm 0.17
T5	6.92 ^c \pm 0.15	6.83 ^c \pm 0.28	6.75 ^c \pm 0.17	6.50 ^d \pm 0.18	6.25 ^c \pm 0.11

Different superscripts in a column differ significantly $P \leq 0.01$

The Overall acceptability scores of Greek yoghurt incorporated with different concentration of *Moringa oleifera* leaf powder during different storage period in 7 °C is presented in table-2. During the different storage period, the statistical analysis revealed that, there was no significant difference noticed in a particular treatment but highly significant ($P \leq 0.05$) difference was noticed between T4, T5 and other three treatments. Hence, it is revealed that, no changes observed in sensory qualities of *Moringa oleifera* leaf powder incorporated Greek yoghurt during storage period.

4. Conclusion

Milk is not a significant source for vitamin c and iron. In addition, like any other dairy products, yoghurt also lacks in dietary fiber content. In this regard, inclusion of dietary fiber, antioxidant and vitamin C rich herbs is expected to enhance the nutritional and therapeutic values of yoghurt and as such encourage consumption of yoghurt. Keeping in mind that, incorporation of *Moringa oleifera* leaf powder that contains Vitamin C seven times more than as present in oranges, fifteen times more Potassium than banana, Calcium seventeen times more than in milk, 10 folds additional vitamin A than carrots and 25 folds' additional iron than spinach with respect to gram-in-gram comparison. It also contains considerable amount of natural antioxidant including ascorbic acid, flavonoid, phenolic and carotenoid (Daba, 2016, Gao *et al.*, 2009) [13] [14]. Hence, it is concluded that the functional Greek yoghurt can be prepared by incorporating *Moringa oleifera* leaf powder at the rate of 1.5% and sugar at the rate of 15% without altering their sensory properties and also enhance the nutritional and therapeutic values of functional Greek yoghurt.

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